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ABSTRACT

This skills inventory for mining occupations was developed by a technical committee in Montana to assist in the development of model curricula and to address state labor market needs. The committee included employers from the mining industry, members of trade and professional associations, and educators. The validated task list and defined job clusters are intended to provide information on the type and level of knowledge and skills needed for entry, retention, and advancement in Montana mining occupations. The guide contains the following: (1) Montana supply and demand occupational information; (2) occupational characteristics of selected jobs in the mining industry; and (3) task lists for seven major areas of training in mining and minerals--geology, soils, and hydrology; land reclamation; heavy equipment operators and maintenance; surveying; drafting and computer-aided design; petroleum technology; and occupational health, safety, and materials handling. The document includes information on training time for mining occupations; mathematics and language training time; physical demands; and environmental working conditions. (KC)

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TECHNICAL COMMITTEE ON OCCUPATIONAL CURRICULUM DEVELOPMENT

CE053 273

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MINING AND MINERALS

TECHNICAL ADVISORY COMMITTEE

ON CURRICULUM DEVELOPMENT

JOB CLUSTERS, COMPETENCIES AND TASK ANALYSIS

Completed by the Montana
Center for Vocational Education Research,
Curriculum and Personnel Development
Located at Northern Montana College
P.O. Box 7751
Havre, Montana 59501

December 1988

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Particular thanks go to:

- Northwest Curriculum Coordination Center
  Saint Martin's College, Lacey, Washington

- Research and Analysis Bureau, Montana Department of
  Labor & Industry, Helena, Montana

- Department of Vocational Education, Colorado State University,
  Fort Collins, Colorado;

INTRODUCTION

The Carl D. Perkins Vocational Education Act (Public Law 98-524) was enacted in 1984 to replace the Vocational Education Act of 1963 and its subsequent amendments. It is the major vehicle for federal support of vocational education to the states.

The Perkins Act heralded a desire by Congress to better target the responsiveness of vocational and technical education and training to the requirements of the marketplace. The Act sets forth guidelines for implementing this desire by mandating significantly greater involvement of business and industry in the curriculum development process through the mechanism of State Technical Committees.

The Montana State Office of the Commissioner of Higher Education, with the assistance of the State Council for Vocational Education designated 14 distinct business and industry areas for future Technical Committee organization. Five Technical Committees were established for 1988-89 to assist in the development of model curricula and to address state labor market needs. The five committees were responsible for developing an inventory of skills that may be used to define state-of-the-art model curricula for Montana. The five designated committees are:

- TOURISM AND TRAVEL
- AGRICULTURE
- FORESTRY AND LUMBERING
- HEALTH CARE
- MINING AND MINERALS

Montana's Technical Committees represented employers from the industry or occupations for which the committee was established; members from trade or professional organizations representing relevant occupations, and members of organized labor (where appropriate).

Committee members met twice during Fall 1988 to validate relevant skills inventory lists for the foundation of curriculum development. Staff from the Center for Vocational Education served as facilitators. This validated task list and defined job clusters should provide the type and level of knowledge and skills needed for entry, retention, and advancement in Montana.

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MONTANA SUPPLY AND DEMAND INFORMATION

A continuing challenge facing education and training institutions is to identify, design, and offer training programs that serve both the needs of individual participants and the needs of the economy and society as a whole. It is crucial that training programs designed to prepare individuals for specific occupations be realistic in light of anticipated job openings (demand) and the expected number of persons available for and prepared to fill them (supply).

The following projected information can assist in looking into the future job market with some confidence. Through the use of the information individuals and jobs can be matched, thereby decreasing unemployment and increasing job satisfaction. This will also benefit the business community and taxpayers. Through the use of this information, better decisions can be made for the future by having a more realistic knowledge of Montana's employment trends.

The following tables and statistics have been taken from the Montana Supply and Demand Report, Fifth Edition, October 1988, Montana State Occupational Information, Coordinating Committee.

MONTANA MINING AND MINERALS OCCUPATIONAL
DEMAND REPORT 1986-1995

OCCUPATIONAL AREA	1986 EMPLOY.	1995 EMPLOY.	EST. ANNUAL OPENINGS
SOIL AND WATER ANALYSIS			
Conservation Scientist	688	743	13
Mining and Related Managers	134	144	6
LAND RECLAMATION			
Water and Waste Treatment Plant Op.	355	398	6
Chemical Technicians	103	105	3
HEAVY EQUIPMENT OPERATIONS AND MAINTENANCE			
Machinery Mechanics: Plant Operations	136	154	7
All Other Machinery Mechanics	414	419	17
Machinery Maintenance Workers	201	223	11
Mobile Heavy Equipment Mechanics	573	665	28
Grader, Dozer, Scraper Operators	384	467	50
Industrial Truck and Tractor Operators	716	649	- 1
Operating Engineers	1210	1373	57
SURVEYING AND DRAFTING			
Surveying and Mapping Technicians	334	389	16
All Other Engineering Technicians	441	495	15
Drafters	459	531	11
Civil Engineering Technicians	409	456	13
PETROLEUM TECHNOLOGY			
Welders and Cutters	712	832	25
Mining Engineers	111	137	4
Petroleum Technicians & Technologists	16	18	0
Blasters and Explosive Workers	111	122	5
Derrick Operators, Oil and Gas	68	69	0
Mine Cutting Machine Operators	139	144	2
All Other Mining Machine Operators	24	27	0
Oil Pumpers, Except Well Head	52	52	1
Well Head Pumpers	118	119	3
Petroleum Refinery Operators	8	7	0
Excavation Loading Machine Operators	274	326	19

MONTANA SUMMARY OF JOB CLUSTERS IN DESCENDING ORDER BY DEMAND, (ESTIMATED ANNUAL OPENINGS VS. TRAINING COMPLETERS)

CLUSTER TITLE	DEMAND	SUPPLY
Sales	1482	554
Institutional and Building Service	822	117
Food Production	523	132
Nursing Assistant	262	138
Heavy Equipment Repair and Operation	229	96
Office and Information Services	188	76
Recreation and Tourism	156	205
Other Medical Technology	150	238
Horticulture and Landscaping	113	24
Electrical and Electronic Technology	106	279
Natural Resources Technology	97	217
Forestry and Lumber Production	64	129
Medical Laboratory	59	193
Dental Technology	56	31
Agriculture Business	55	178
Agriculture Production	36	440
Radiologic Technology	31	22
Medical Records	27	47
Environmental Control Technology	25	24
Marketing Management	14	87
Agriculture Mechanics	12	37
Mechanical Technology	10	105
Emergency Medical Technology	9	1
Fish and Wildlife	3	75

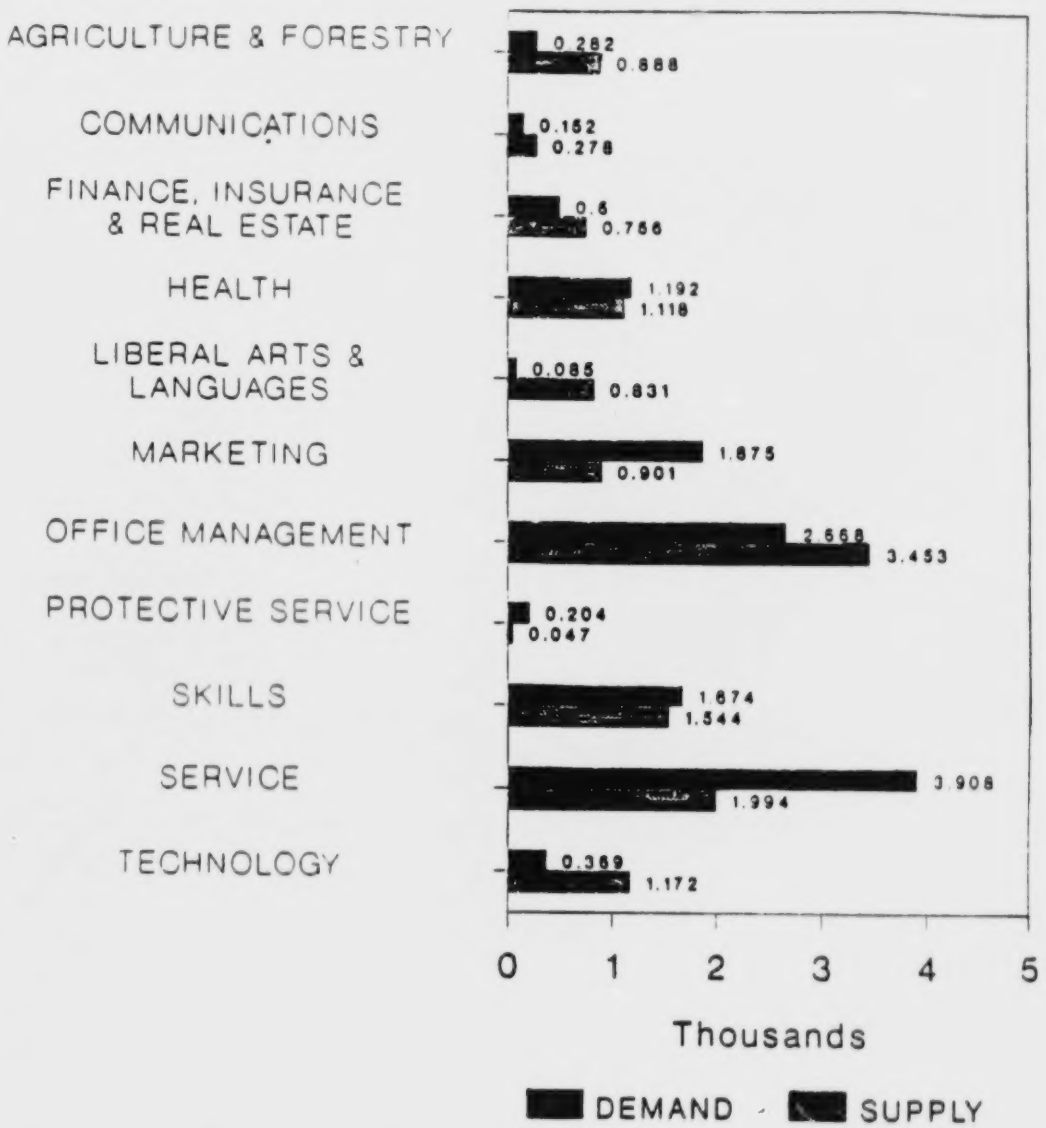
These clusters are representative of clusters found within one or more of the five designated technical advisory committees industry areas: Agriculture, Forestry, Mining and Minerals, Travel and Tourism, and Health Services.

MONTANA OCCUPATIONS RANKED BY ANNUAL OPENINGS TO 1995

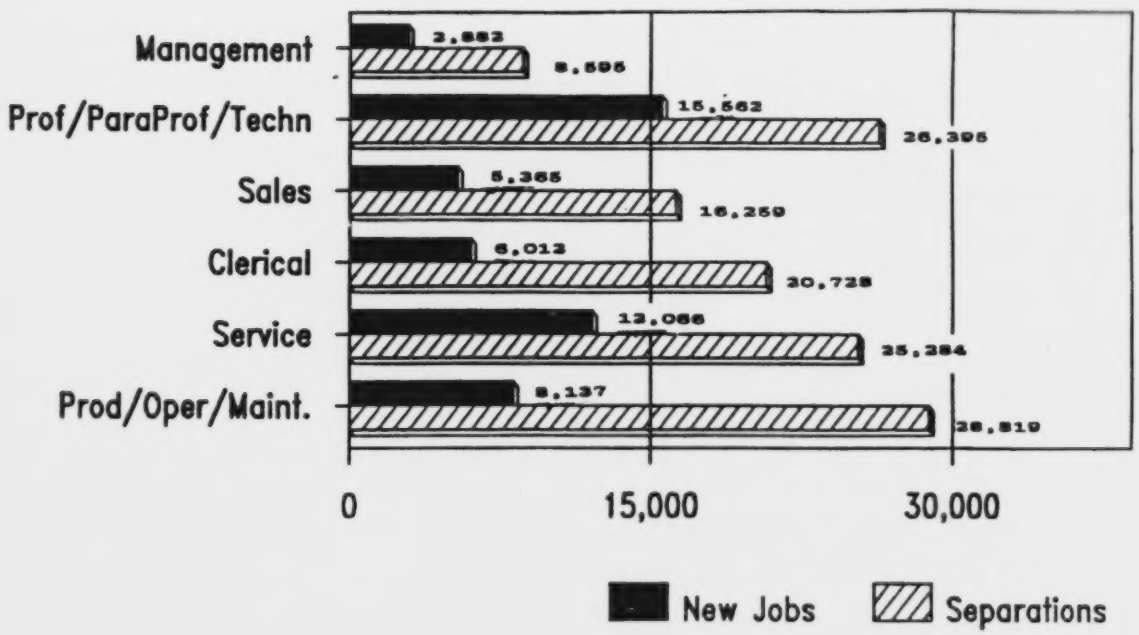
OCCUPATIONAL TITLE	ANNUAL OPENINGS TO 1995
Salespersons, Retail	604
Janitors and Cleaners, excluding Maids	498
Cashiers	324
Waiters and Waitresses	213
Nursing Aides and Orderlies	204
Maids and Housekeeping Cleaners	187
Restaurant Cooks	170
Bartenders	151
Licensed Practical Nurses	108
Gardeners and Groundskeepers	105
Fast Food and Short Order Cooks	105
Combination Food Preparations and Service	97
Institutional or Cafeteria Cooks	88
Food Preparation Workers	88
Receptionists, Information Clerks	75
Institutional Housekeepers	72
Hotel Desk Clerks	65
Food Service and Lodging Managers	65
Guards and Watch Guards	60
Grader, Dozer, Scraper Operators	50
Home Health Aides	44
All Other Foods Service Workers	44
All Other Cleaning, Building Services	43
Bus, Truck, Diesel Eng. Mechanic	40
Bakers, Bread and Pastry	32
Radiologic Technologists and Technicians	30
Butchers and Meat Cutters	29
Dining Room and Bartender Helpers	29
Mobile Heavy Equipment Mechanics	28
Hosts and Hostesses: Restaurant and Lounges	28
Medical Secretaries	27
Amusement and Recreation Attendants	26
All Other Health Service Workers	25
Welders and Cutters	25
All Other Agriculture, Forestry, Fishery Personnel	24
Advertising Sales Agents	23
Travel Agents	23
Machinists	23
Reservation and Transportation Ticket Agent	22
Marketing, Advertising, Public Relations Managers	21
Forest and Conservation Workers	19
Counter and Rental Clerks	19
Excavation Loading Machine Operators	19
Dental Assistants	18
All Other Machinery Mechanics	17
Farm and Home Management Advisors	16
Fallers and Buckers	16
Medical/Clinical Laboratory Technologists	16

Electrical and Electronic Technicians	16
Surveying and Mapping Technicians	16
Medical Assistants	14
Medical Records Technicians and Technologists	13
Sawing Machine Operator, Tender	13
Farm Purchasing Agents and Buyers	11
Machinery Maintenance Workers	11
Millwrights	10
Farm Equipment Mechanics	9
Nursery Workers	8
Logging Tractor Operators	7
Medical/Clinical Laborator Technicians	6
Mining and Related Managers	6
Emergency Medical Technicians	6
Tool Grinders, Filers, Sharpeners	6
Log Handling Equipment Operators	5
Physical Therapy Assistant	5
Recreation Workers	5
Ushers, Lobby Attendants, Ticket Takers	5
Biological, Agriculture Food Technicians	4
First Line Supervisor, Agriculture, Forestry, Fisheries	4
Pharmacy Assistants	4
Choke Setters	3
Crane and Towing Operators	3
Wood Machinists	3
Parking Lot Attendants	3
Well Head Pumpers	3
Curators, Archivists, Museum Technicians	2
Head Sawyers	2
Mine Cutting Machine Operators	2
Agriculture Production Graders and Sorters	1
Log Graders and Scalers	1
Nuclear Medicine Technologists	1
Occupational Therapy Assistants	1

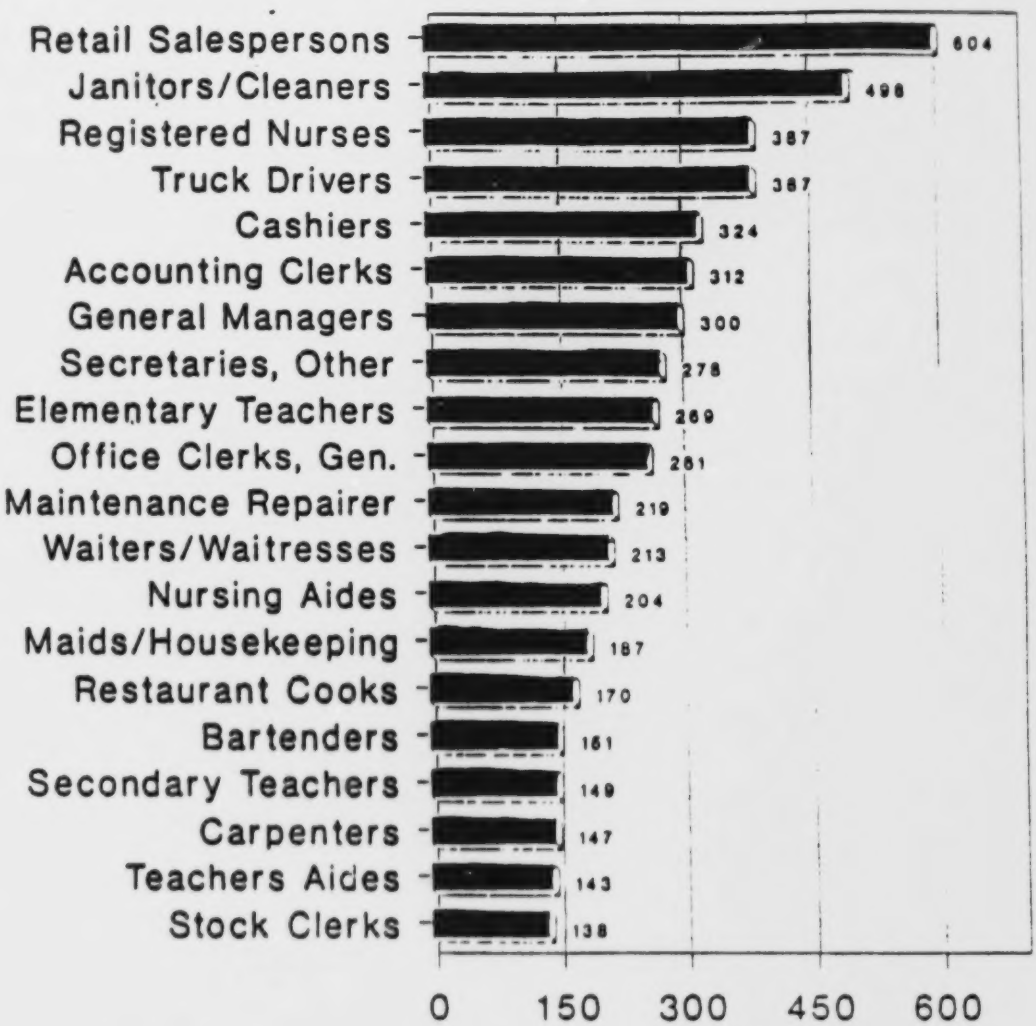
MONTANA CLUSTERS
DEMAND VS. SUPPLY
ESTIMATED ANNUAL OPENINGS VS. TRAINING COMPLETERS



Total Job Openings
Montana Occupations
Growth vs Separations



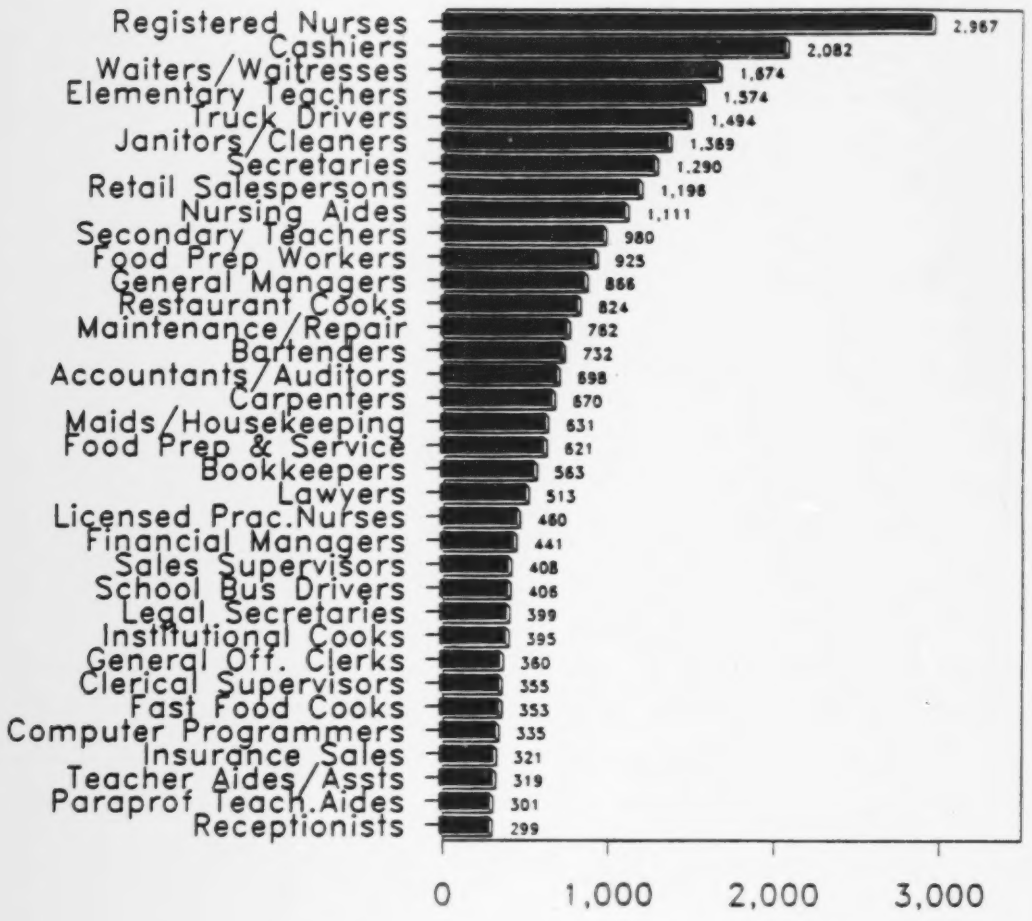
MONTANA
HIGH GROWTH OCCUPATIONS
Estimated Annual Openings to 1995



Montana Job Growth

High Growth Careers

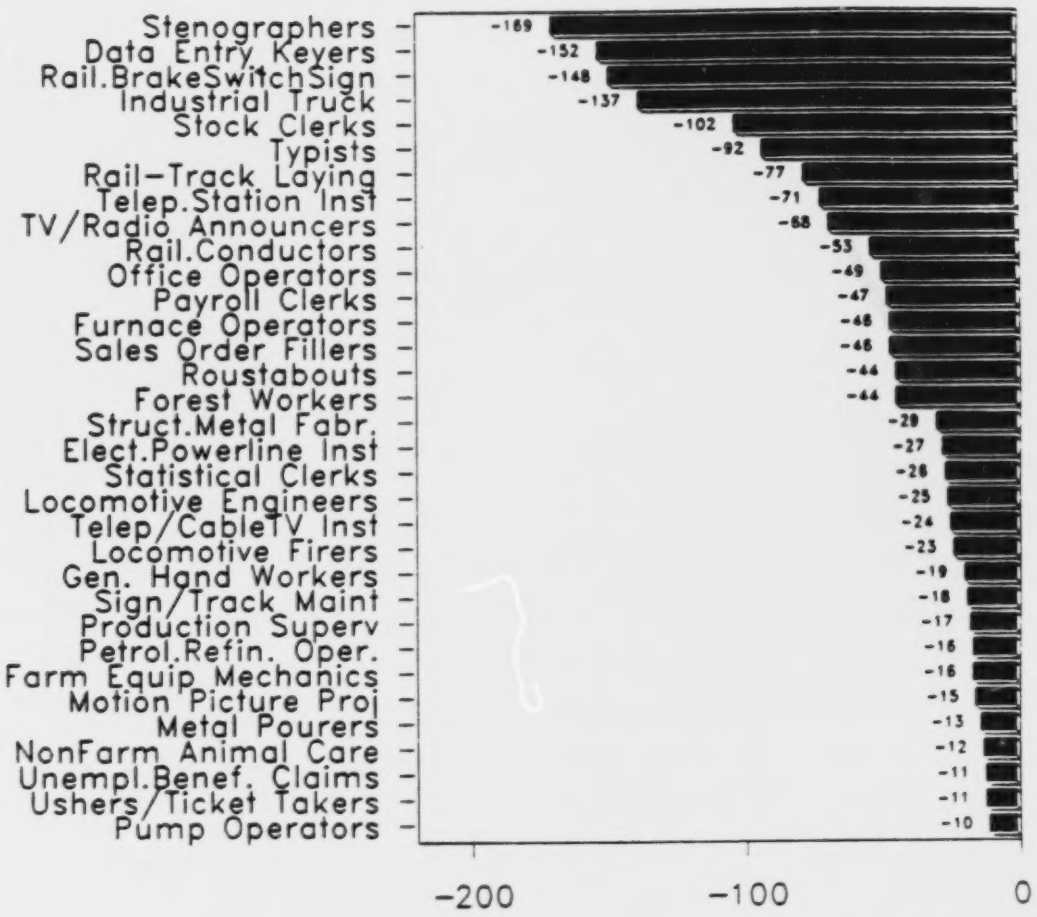
Specific Jobs



Montana Job Growth

Declining Job Areas

Specific Jobs



Occupational Characteristics of Selected Jobs in the Mining and Minerals Industry

The following list of occupations are representive of the Mining and Minerals Industry. While not all of them are found in Montana, they do however represent the most common job titles in the industry.

The selected occupational characteristics are taken from the Dictionary of Occupational Titles and the code to the numbers or letters found in each column is given on the pages following this list. The column marked SVP identifies the Specific Vocational Preparation, or the amount of time required to be trained for the job. The GED columns are marked R M L and are coded to describe the reading, mathematical and language development level necessary to meet the job requirements. The physical demands are noted in the next six columns and the environmental working conditions are coded in the last seven columns.

CIP	DICTIONARY OF OCCUPATIONAL TITLES		GED			PHYSICAL	WORKING
CODE	CODE	TITLE	SVP	R	M	L	DEMANDS	CONDITIONS
(15.0901)	181.117-014	MINE SUPERINTENDENT	8	5	4	4	L 5	B
(15.0903)	181.167-010	MANAGER, FIELD PARTY, GEOPHYSICAL PROSPECTING	6	4	4	4	L 4	B
(15.0903)	181.167-014	SUPERINTENDENT, DRILLING AND PRODUCTION	8	5	5	4	L 5	B 5
(00.0000)	181.167-018	SUPERVISOR, MINE	8	4	3	3	L 56	B
(00.0000)	011.061-014	METALLOGRAPHER	8	5	5	5	S 4 6	I
(00.0000)	011.061-018	METALLURGIST, EXTRACTIVE	8	6	6	6	L 4 6	I
(00.0000)	011.061-022	METALLURGIST, PHYSICAL	8	6	6	6	L 4 6	I
(00.0000)	P010.061-010	DESIGN ENGINEER, MINING-AND-OILFIELD EQUIPMENT	8	5	5	5	L 456	B
(00.0000)	010.061-014	MINING ENGINEER	8	5	5	5	L 456	B 4 67
(00.0000)	P010.061-022	RESEARCH ENGINEER, MINING-AND-OIL-WELL EQUIPMENT	8	5	5	5	L 456	I
(00.0000)	010.061-026	SAFETY ENGINEER, MINES	8	5	5	5	L23456	B 4 67
(00.0000)	P010.061-030	TEST ENGINEER, MINING-AND-OILFIELD EQUIPMENT	8	5	5	5	L 456	B
(00.0000)	024.061-010	CRYSTALLOGRAPHER	8	6	6	6	L 4 6	I
(00.0000)	024.061-018	GEOLOGIST	8	6	6	6	L234 6	B
(00.0000)	024.061-022	GEOLOGIST, PETROLEUM	8	6	6	5	L234 6	B234 7
(00.0000)	024.061-026	GEOPHYSICAL PROSPECTOR	8	6	6	6	L 4 6	B
(00.0000)	024.061-030	GEOPHYSICIST	8	6	5	5	L 4 6	B
(00.0000)	024.061-034	HYDROLOGIST	8	6	6	6	L 4 6	B
(00.0000)	024.061-038	MINERALOGIST	8	6	6	6	L 4 6	B
(00.0000)	024.061-042	PALEONTOLOGIST	8	6	6	6	L234 6	B
(00.0000)	024.061-046	PETROLOGIST	8	6	6	5	L 4 6	B
(00.0000)	024.061-050	SEISMOLOGIST	8	6	6	6	L 4 6	B
(00.0000)	024.061-054	STRATIGRAPHER	8	6	6	5	L 4 6	B
(00.0000)	024.161-010	ENGINEER, SOILS	7	6	5	6	L 4 6	B
(00.0000)	024.167-010	GEOPHYSICAL-LABORATORY CHIEF	9	6	6	6	L 5	I
(47.0302)	620.261-022	CONSTRUCTION-EQUIPMENT MECHANIC	7	3	3	3	M 34 6	B 5 7
(47.0302)	620.281-042	LOGGING-EQUIPMENT MECHANIC	7	4	3	3	V23456	B 56
(47.0604)	620.381-014	MECHANIC, ENDLESS TRACK VEHICLE	7	4	3	3	M 34	I
(49.0306)	806.261-014	RIGGER	7	4	2	2	H23456	B 6
(49.0306)	806.261-018	RIGGER APPRENTICE	7	4	2	2	H23456	B 6
(49.0202)	921.260-010	RIGGER	6	4	2	2	H234 6	B 56
(03.0405)	P921.664-014	RIGGER	5	3	2	2	V234 6	O 6
(00.0000)	962.664-010	HIGH RIGGER	6	3	2	2	V23456	I 6

CIP CODE	DICTIONARY OF OCCUPATIONAL TITLES CODE	TITLE	SVP	GED R	GED M	GED L	PHYSICAL DEMANDS	WORKING CONDITIONS	
(00.0000)	850.381-010	MINER	7	4	3	2	H234 6	I	4567
(00.0000)	859.261-010	BLASTER	7	4	4	4	H234 6	B	567
(47.0305)	931.361-018	SHOOTER, SEISMOGRAPH	6	3	2	2	M 45	O	6
(47.0305)	931.382-010	PERFORATOR OPERATOR, OIL WELL	6	3	2	2	H234 6	B	6
(49.0204)	931.664-010	TIER-AND-DETONATOR	2	2	2	2	M 34	O	6
(49.0204)	850.663-026	STRIPPING-SHOVEL OPERATOR	5	3	1	1	M2 4 6	I	56
(49.0202)	850.683-026	MUCKING-MACHINE OPERATOR	3	3	1	1	L2 456	I	4567
(49.0202)	850.683-030	POWER-SHOVEL OPERATOR	5	3	1	1	M 4 6	B	5
(49.0202)	850.663-014	ELEVATING-GRADER OPERATOR	6	3	1	1	M 4 6	O	5 7
(49.0202)	850.663-022	MOTOR-GRADER OPERATOR	5	3	1	1	L 4 6	O	5 7
(01.0204)	850.683-010	BULLDOZER OPERATOR 1	5	3	1	2	H23456	O	67
(49.0202)	850.683-014	DITCHER OPERATOR	4	3	1	1	L 4 6	O	5
(49.0202)	850.683-022	FORM-GRADER OPERATOR	4	3	2	1	L 4 6	O	
(49.0202)	850.683-038	SCRAPER OPERATOR	5	3	1	2	L 4 6	O	5 7
(49.0202)	850.683-046	UTILITY-TRACTOR OPERATOR	4	3	1	1	L 4 6	O	56
(49.0202)	859.683-010	OPERATING ENGINEER	6	4	2	2	M 34 6	B	56
(49.0202)	859.683-014	OPERATING-ENGINEER APPRENTICE	6	4	2	2	M 34 6	B	56

Specific Vocational Preparation
(Training Time)

This represents the amount of time required to learn the techniques, acquire information, and develop the facility needed for average performance in a specific job-worker situation. The training may be acquired in a school, work, military, institutional, or a vocational environment. It does not include orientation training required of even every fully qualified worker to become accustomed to the special conditions of any new job. Specific vocational training includes training given in any of the following circumstances:

a. Vocational education (such as high school commercial or shop training, technical school, art school, and that part of college training which is organized around a specific vocational objective);
b. Apprentice training (for apprenticeable jobs only);
c. In-plant training (given by an employer in the form of organized classroom study);
d. On-the-job training (serving as learner or trainee on the job under the instruction of a qualified worker);
e. Essential experience in other jobs (serving in less responsible jobs which lead to the higher grade job or serving in other jobs that qualify).

The following is an explanation of the various levels of specific vocational preparation.

Short demonstration.

Level	Time
1	Short demonstration.
2	Anything beyond short demonstration up to and including 30 days.
3	Over 30 days up to and including 3 months.
4	Over 3 months up to and including 6 months.
5	Over 6 months up to and including 1 year.
6	Over 1 year up to and including 2 years.
7	Over 2 years up to and including 4 years.
8	Over 4 years up to and including 10 years.
9	Over 10 years.

Mathematical Development and Language Development (Training Time)

Commonly referred to as "tool knowledges," these embrace those aspects of education (formal and informal) of a general nature that contribute to the acquisition of such skills but do not have a recognized, fairly specific, occupational objective, ordinarily obtained in elementary, high school, or college environs and augmented by past experiences and self-study. They provide linkage between norms used for interpretation of the Basic Occupational Literacy Test (BOLT) scores and level requisites for DOT occupations. Following are the definitions and scale levels applicable to each:

a. Mathematical Developmental or Arithmetic Computation (M): The acquisition of basic mathematical skills, not specifically vocationally oriented, such as the ability to solve arithmetic, algebraic, and geometic problems ranging from fairly elemental to dealing with abstractions.

b. Language Development or Literacy Training (L): The acquisition of language skills, not specifically vocationally oriented, such as mastery of an extensive vocabulary; use of correct sentence structure, punctuation, and spelling; and an appreciation of literature.

Level	*Mathematical Development*	*Language Development*
6	Advanced calculus: Work with limits, continuity, real number systems, mean value theorems, and implicit function theorems. Modern algebra: Apply fundamental concepts of theories of groups, rings, and fields. Work with differential equations, linear algebra, infinite series, advanced operations methods, and functions of real and complex variables. Statistics: Work with mathematical statistics, mathematical probability, and applications, experimental design, statistical inference, and econometrics.	Reading: Read literature, book and play reviews, scientific and technical journals, abstracts, financial reports, and legal documents. Writing: Write novels, plays, editorials, journals, speeches, manuals, critiques, poetry, and songs. Speaking: Conversant in the theory, principles, and methods of effective and persuasive speeking, voice and diction, phonetics, and discussion and debate.

Level	*Mathematical Development*	*Language Development*
5	Algebra: Work with exponents and logarithms, linear equations, quadratric equations, mathematical induction and binomial theorems, and permutations. Calculus: Apply concepts of analytical geometry, differentiations and integration of algebraic functions with applications. Statistics: Apply mathematical operations to frequency distributions, reliability, and validity of tests, normal curve, analysis of variance, correlation techniques, chi-square application and sampling theory, and factor analysis.	Same as level 6
4	Algebra: Deal with system of real numbers; linear, quadratic, rational, exponential; logarithmic, angle, and circular functions, and inverse functions; related algebraic solution of equations and inequalities; limits and continuity, and probability and statistical inference. Geometry: Deductive axiomatic geometry, plane and solid; and rectangular coordinates. Shop Math: Practical application of fractions, percentages, ratio and proportion, mensuration, logarithms, slide rule, practical algebra, geometric construction, and essentials of trigonometry.	Reading: Read novels, poems, newspapers, periodicals, journals, manuals, dictionaries, thesauruses, and encyclopedias. Writing: Prepare business letters, expositions, summaries, and reports, using prescribed format, and conforming to all rules of punctuation, grammar, diction, and style. Speaking: Participate in panel discussions, dramatizations, and debates. Speak extemporaneously on a variety of subjects.
3	Compute discount, interest, profit, and loss; commission, markups, and selling price; ratio and proportion, and percentages. Calculate surfaces, volumes, weights, and measures. Algebra: Calculate variables and formulas, monomials and polynomials; ratio and proportion variables; and square roots and radicals. Geometry: Calculate plane and solid figures, circumference, area, and volume. Understand kinds of angles, and properties of pairs and angles.	Reading: Read a variety of novels, magazines, atlases, and encyclopedias. Read safety rules, instructions in the use and maintenance of shop tools and equipment, and methods and procedures in mechanical drawing and layout work. Writing: Write reports and essays with proper format, punctuation, spelling, and grammar, using all parts of speech. Speaking: Speak before an audience with poise, voice control, and confidence, using correct English and well-modulated voice.

Level	*Mathematical Development*	*Language Development*
2	Add, subtract, multiply, and divide all units of measure. Perform the four operations with like common and decimal fractions. Compute ratio, rate, and percent. Draw and interpret bar graphs. Perform arithmetic operations involving all American monetary units.	Reading: Passive vocabulary of 5,000-6,000 words. Read at rate of 190-215 words per minute. Read adventure stories and comic books, looking up unfamiliar words in dictionary for meaning, spelling, and pronunciation. Read instructions for assembling model cars and airplanes. Writing: Write compound and complex sentences, using cursive style, proper end punctuation, and employing adjectives and adverbs. Speaking: Speak clearly and distinctly with appropriate pauses and emphasis, correct pronunciation, variations in word order, using present, perfect, and future tenses.
1	Add and subtract two digit numbers. Multiply and divide 10's and 100's by 2, 3, 4, 5. Perform the four basic arithmetic operations with coins as part of a dollar. Perform operations with units such as cup, pint, and quart; inch, foot, and yard; and ounce and pound.	Reading: Recognize meaning of 2,500 (two- or three-syllable) words. Read at a rate of 95-120 words per minute. Compare similarities and differences between words and between series of numbers. Writing: Print simple sentences containing subject, verb, and object, and series of numbers, names, and addresses. Speaking: Speak simple sentences, using normal word order, and present and past tenses.

Physical Demands

The physical demands listed in this publication serve as a means of expressing both the physical requirements of the job and the physical capacities (specific physical traits) a worker must have to meet those required by many jobs (perceiving by the sense of vision), and also the name of a specific capacity possessed by many people (having the power of sight). The worker must possess physical capacities at least in an amount equal to the physical demands made by the job.

The Factors

I. Strength: This factor is expressed in terms of *Sedentary, Light, Medium, Heavy,* and *Very Heavy.* It is measured by involvement of the worker with one or more of the following activities:

a. Worker position(s):

(1) *Standing:* Remaining on one's feet in an upright position at a workstation without moving about.
(2) *Walking:* Moving about on foot.
(3) *Sitting:* Remaining in the normal seated position.

b. Worker movement of objects (including extremities used);

(1) *Lifting:* Raising or lowering an object from one level to another (includes upward pulling).
(2) *Carrying:* Transporting an object, usually holding it in the hands or arms or on the shoulder.
(3) *Pushing:* Exerting force upon an object so that the object moves away from the force (includes slapping, striking, kicking, and treadle actions).
(4) *Pulling:* Exerting force upon an object so that the object moves toward the force (includes jerking).

The five degrees of Physical Demands Factor No. 1 (strength), are as follows:

S Sedentary Work

Lifting 10 lbs. maximum and occasionally lifting and/or carrying such articles as dockets, ledgers, and small tools. Although a sedentary job is defined as one which involves sitting, a certain amount of walking and standing is often necessary in carrying out job duties. Jobs are sedentary if walking and standing are required only occasionally and other sedentary criteria are met.

L Light Work

Lifting 20 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 10 lbs. Even though the weight lifted may be only a negligible amount, a job is in this category when it requires walking or standing to a significant degree, or when it involves sitting most of the time with a degree of pushing and pulling of arm and/or leg controls.

M Medium Work

Lifting 50 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 25 lbs.

H Heavy Work

Lifting 100 lbs. maximum with frequent lifting and/or carrying of objects weighing up to 50 lbs.

V Very Heavy Work

Lifting objects in excess of 100 lbs. with frequent lifting and/or carrying of objects weighing 50 lbs. or more.

2. *Climbing and/or Balancing*
   (1) Climbing: Ascending or decending ladders, stairs, scaffolding, ramps, poles, ropes, and the like, using the feet and legs and/or hands and arms.
   (2) Balancing: Maintaining body equilibrium to prevent falling when walking, standing, crouching, or running on narrow, slippery, or erratically moving surfaces; or maintaining body equilibrium when performing gymnastic feats.

3. *Stooping, Kneeling, Crouching, and/or Crawling:*
   (1) Stooping: Bending the body downward and forward by bending the spine at the waist.
   (2) Kneeling: Bending the legs at the knees to come to rest on the knee or knees.
   (3) Crouching: Bending the body downward and forward by bending the legs and spine.
   (4) Crawling: Moving about on the hands and knees or hands and feet.

4. *Reaching, Handling, Fingering, and/or Feeling:*
   (1) Reaching: Extending the hands and arms in any direction.
   (2) Handling: Seizing, holding, grasping, turning, or otherwise working with the hand or hands (fingering not involved).
   (3) Fingering: Picking, pinching, or otherwise working with the fingers primarily (rather than with the whole hand or arm as in handling).
   (4) Feeling: Perceiving such attributes of objects and materials as size, shape, temperature, or texture, by means ot receptors in the skin, particularly those of the fingertips.

5. *Talking and/or Hearing:*
   (1) Talking: Expressing or exchanging ideas by means of the spoken word.
   (2) Hearing: Perceiving the nature of sounds by the ear.

6. *Seeing:* Obtaining impressions through the eyes of the shape, size, distance, motion, color, or other characteristics of objects. The major visual functions are: (1) acuity, far and near, (2) depth perception, (3) field of vision, (4) accommodation, and (5) color vision. The functions are defined as follows:

   (1) Acuity, far—clarity of vision at 20 feet or more. Acuity, near—clarity of vision at 20 inches or less.
   (2) Depth perception—three-dimensional vision. The ability to judge distance and space relationships so as to see objects where and as they actually are.
   (3) Field of vision—the area that can be seen up and down or to the right or left while the eyes are fixed on a given point.
   (4) Accommodation—adjustment of the lens of the eye to bring an object into sharp focus. This item is especially important when doing near-point work at varying distances from the eye.
   (5) Color vision—the ability to identify and distinguish colors.

Environmental Working Conditions

Environmental conditions are the physical surroundings of a worker in a specific job.

1. *Inside, Outside, or Both:*
   I Inside: Protection from weather conditions but not necessarily from temperature changes.
   O Outside: No effective protection from weather.
   B Both: Inside and outside.

A job is considered "inside" if the worker spends approximately 75 percent or more of the time inside, and "outside" if the worker spends approximately 75 percent or more of the time outside. A job is considered "both" if the activities occur inside or outside in approximately equal amounts.

2. *Extremes of Cold Plus Temperature Changes:*
   (1) Extremes of Cold: Temperature sufficiently low to cause marked bodily discomfort unless the worker is provided with exceptional protection.
   (2) Temperature Changes: Variations in temperature which are sufficiently marked and abrupt to cause noticeable bodily reactions.

3. *Extremes of Heat Plus Temperature Changes:*
   (1) Extremes of Heat: Temperature sufficiently high to cause marked bodily discomfort unless the worker is provided with exceptional protection.
   (2) Temperature Changes: Same as 2(2).

4. *Wet and Humid:*
   (1) Wet: Contact with water or other liquids.
   (2) Humid: Atmospheric condition with moisture content sufficiently high to cause marked bodily discomfort.

5. *Noise and Vibration:* Sufficient noise, either constant or intermittent, to cause marked distraction or possible injury to the sense of hearing, and/or sufficient vibration (production of an oscillating movement or strain on the body or its extremities from repeated motion or shock) to cause bodily harm if endured day after day.

6. *Hazards:* Situations in which the individual is exposed to the definite risk of bodily injury.

7. *Fumes, Odors, Toxic Conditions, Dust, and Poor Ventilation:*
   (1) Fumes: Smoky or vaporous exhalations, usually odorous, thrown off as the result of combustion or chemical reaction.
   (2) Odors: Noxious smells, either toxic or nontoxic.
   (3) Toxic Conditions: Exposure to toxic dust, fumes, gases, vapors, mists, or liquids which cause general or localized disabling conditions as a result of inhalation or action on the skin.
   (4) Dust: Air filled with small particles of any kind, such as textile dust, flour, wood, leather, feathers, etc., and inorganic dust, including silica and asbestos, which make the workplace unpleasant or are the source of occupational diseases.
   (5) Poor Ventilation: Insufficient movement of air causing a feeling of suffocation; or exposure to drafts.

Technical Committee on Curriculum Planning

M I N I N G AND M I N E R A L S

The Mining and Minerals Technical Committee divided the industry into these major areas for training.

I. Geology, Soils and Hydrology
II. Land Reclamation
III. Heavy Equipment Operators and Maintenance
IV. Surveying
V. Drafting/Computer Aided Design (CAD)
VI. Petroleum Technology
VII. Occupational Health, Safety and Materials Handling

I. GEOLOGY, SOILS AND HYDROLOGY

A. Gather and Analyze Field Data for Soil and Water Conservation Plans/Baseline Data
- determine significant erosion hazards and other problems related to protection of the environment
- gather drainage area data for watersheds
- record physical and topographical data
- measure stream flow
- measure water level
- determine soil loss

B. Collect and Test, Soil, Water and Air Samples and Assist in Evaluation of the Results
- collect soil/water samples
- collect water samples
- interpret analysis of soil and water samples
- collect test pit information for building purposes
- collect air samples
- interpret analysis of air samples
- interpret basic soil differences

C. Perform Preliminary Survey and Layout Work
- use hand level or engineering level and type
- determine volumes of earth
- locate best site for engineering practices
- measure degree of slope
- evaluate degree of erosion
- make borings and vegetative studies of wet areas
- procure simple easements

D. Interpret Geologic, Topographic and Soil Maps, Aerial Photographs and Legal Descriptions
- locate and identify field boundaries
- use topographical and aerial photographs
- record acreage in field by making measurements
- interpret legal land descriptions
- prepare land capability maps from soil maps and data

E. Demonstrate Conservation Practices
- adapt conservation practices
- demonstrate use of equipment for installation practices
- demonstrate terracing techniques
- determine sites best suited for appropriate vegetation
- demonstrate importance of drains and water courses
- demonstrate seeding and land preparation conservation practices
- compare various range use practices
- interpret technical information for landowner and explain

F. Prepare and Analyze Records and Reports
- keep daily record of work accomplished
- maintain farm plan records
- assist with reports
- prepare reports and presentations
- analyze reports and records
- discuss process of communication
- discuss communication channels
- discuss computers and technology
- discuss electronic communications

G. Interpret Technical Information and Incorporate into Management Practices
- keep and maintain a file of current technical information from universities, governmental agencies and commercial companies
- maintain a reference file for periodicals and other publications
- select and attend seminars and workshops to update skills and knowledge
- list sources of technical and professional information
- interpret design specifications and apply them

H. Manage the Operation and Maintenance of Scientific Test Equipment
- assess needs for the purchase of new or replacement equipment
- manage the maintenance of tools and equipment
- train workers to safely operate and maintain tools and equipment
- develop a general maintenance schedule

I. Identify Wildlife Populations
- identify wildlife species and habitat
- describe the characteristics of wildlife populations
- recognize and interpret wildlife and game laws and regulations

J. Manage the Maintenance of Facilities and Grounds
- develop a general maintenance schedule for facilities and grounds
- supervise employees in maintenance and repair activities
- arrange for repairs and services
- order materials and supplies

K. Supervise Fire Fighting Crews
- determine fire potential in a given area
- use appropriate fire control measures
- identify and correct potential fire dangers
- supervise maintenance of fire lines
- assist in the supervision of fire fighting crews and support services

L. Supervise and Train Employees in their Job and Job Safety
- maintain open communications
- set up work schedules
- provide technical information and data
- provide instruction and training for employees
- maintain personnel records
- maintain employee welfare and safety through training and information

M. Interpret and Apply Laws and Regulations Relative to the Operation
- list agencies responsible for administering regulations relative to occupation
- interpret laws and regulations for landowners
- secure permits and certificates required by law

N. Demonstrate Leadership, Employability, Communication, Human and Public Relations Skills
- conduct a job search
- secure information about a job
- identify documents that may be required when applying for a job
- complete a job application form correctly
- demonstrate competence in job interview techniques
- identify or demonstrate appropriate responses to criticism from employer, supervisor, or other persons
- identify acceptable work habits
- demonstrate knowledge of how to make job changes appropriately
- demonstrate acceptable employee health habits

II. LAND RECLAMATION

A. Work with Equipment and Instruments
- work within laws and regulations
- utilize reclamation potentials of earthmoving equipment
- utilize revegetation equipment
- schedule of equipment and materials
- interpret photos and maps
- use drafting equipment
- use surveying equipment
- use hand tools
- use small power tools

B. Working with Soils
- work within laws and regulations
- interpret soil surveys
- identify soil types
- collect soil samples
- interpret soil sample results
- coordinate stripping, stockpiling and redistribution of topsoils and/or overburden
- coordinate final gradings and shapings
- apply fertilizers and soil amendments
- minimize effects of wind and water erosions

C. Monitoring Water Quality and Quantity
- work within laws and regulations
- collect and analyze samples for water quality
- measure water quantities
- implement pollution abatement measures
- identify types of well construction and development

D. Monitoring Air Quality
- work within laws and regulations
- control fugitive dusts

E. Monitoring Wildlife
- work within laws and regulations
- conduct wildlife surveys
- perform habitat improvements

F. Vegetation/Revegetation Requirements and Plans
- work within laws and regulations
- identify plants
- conduct vegetation inventories
- transplant vegetations
- establish test plots
- recognize nutrient deficiencies of vegetations
- maintain revegetated areas
- prepare seedbeds
- mix and inoculate seeds

- calibrate seeding equipment
- supervise seeding and planting operations
- supervise mulching operations
- apply fertilizers and soil amendments
- maintain irrigation systems
- monitor soil stabilities
- monitor plant establishments
- apply animal control measures
- supervise maintenance programs

G. Monitoring and Reclamation of Waste Pits
- determine extent of problem
- determine reclamation techniques best suited to site problem

H. Monitoring Petroleum Product Spills
- develop monitoring plan
- develop product recovery plan
- develop remediation plan
- develop site safety plan

I. Reporting Activities and Data
- write inspection reports
- document daily work activities
- take photos for documentation
- prepare visual aids
- present oral reports
- assist in completing permit applications
- assist in completing compliance reports
- record baseline data

J. Working with People
- work with regulatory agencies
- supervise work crews
- work with management
- work with labor
- coordinate activities of contractors and research agencies
- implement company policies and procedures

III. HEAVY EQUIPMENT OPERATORS AND MAINTENANCE

A. Operator Procedures
- identify equipment safety checks
- identify specific equipment operations
- check equipment limitations
- check terrain

B. Operational skills

Loader

-load trucks
-load scrapers
-stockpile
-clean work area
-keep work area level
-learn short cycle

Graders
-rough blade level areas
-blade road surface
-ditching
-sloping

Backhoe
-trenching
-dig pits
-bury pipe
-dig pipe

Dump trucks
-haul material
-pile and/or spread dump

5th Wheel tractors
-operate fifth-wheel tractor

Track-type tractors
-push material over a distance
-dig pit
-stockpile material
-push load scraper
-pull load wheel scraper

Excavator
-dig trenches
-dig pit

Scrapers
-dig trenches
-haul material
-level material on work pad

Cranes
- load rigging
- check equipment load limitations
- identify equipment load limitations

C. Heavy Equipment Mechanics
-maintain safe work environments
-operate machines
-troubleshoot and repair hydraulic systems
-use tools and shop equipment
-keep records
-troubleshoot and repair power train systems
-perform engine repairs
-troubleshoot and repair air and brake systems
-identify proper disposal methods for oils and solvents

IV. SURVEYING

A. Survey and Measure Lands
-identify parcels of land based on legal descriptions
-interpret aerial photographs
-survey site boundaries and acreage
-produce finished map of area
-determine topography
-identify underground surveying techniques
-mark boundaries and corners
-make linear measurements
-clear brush
-set up surveying instruments
-use maps to locate and report position
-identify uses for satellite triangulation

B. Survey and Measure Forests
-operate current tree measuring devices
-estimate timber volumes by product
-select and use tree volume tables
-timber stand growth projection
-demonstrate sampling techniques
-determine forest stocking rate

C. Interpret aerial photographs and maps
-measure acreage
-use photo scales
-record measurements on photos or in records
-make rough tracings of maps
-interpret real estate and/or legal descriptions
-determine location and other information from maps

V. DRAFTING COMPUTER-AIDED DESIGN (CAD)

A. Operate System
- boot system/start up procedure
- log in/on terminal
- load start file
- execute drawing assignment
- manage files
- plot out drawings
- store a file
- shut down a system
- log off/out

B. Execute Drawing Assignment
a. Change existing drawings or details
- plan drawing changes
- find drawing file
- load drawing file
- executive changes
- obtain approvals/check drawing changes
- plot out drawing
- update file

b. Document original designs
- plan drawing layout
- load start file
- execute detailed drawings
- obtain approvals
- plot out drawings
- store files

C. Execute/Change Detailed Drawings
- set up drawing
- create drawing components
- confer with designer/engineer
- compose drawings

D. Compose Drawings
- understand and use system commands
- create and manipulate geometry
- select geometry
- add text
- rotate views
- move views
- scale views
- dimension a drawing

VI. PETROLEUM TECHNOLOGISTS

A. Using Hand Tools
- maintain hand tools
- use pipe tools such as wrenches, cutters and threaders
- use wire cutters and stretchers
- use post hole diggers
- use shovels and picks
- use sledgehammers and other hammers
- use chisels and pry bars
- use levels, plumb bobs and calipers
- use tape measures
- use squares
- use lubricating devices such as grease guns and oil cans
- use chain tighteners
- use wrenches such as sockets and adjustable wrenches
- use marking devices
- use jacks such as hydraulic and mechanical jacks
- use tachometers
- use hydrometers
- use other small hand tools such as screwdrivers, pliers and brushes

B. Using Power Tools
- maintain power tools
- use grinders
- use chain saws
- use adding machines and calculators
- use drills such as electric and pneumatic drills
- use portable electric saws
- use electric brushes
- use wrenches such as electric and pneumatic wrenches
- use paint sprayers

C. Operating Equipment
- operate mud pumps
- operate shale shakers
- operate engines such as diesel and gas engines
- operate catheads
- maintain blocks and hooks
- maintain swivels
- maintain sheaves
- operate hand and power tongs such as makeup and breakout tongs
- operate rotary tables
- operate blowout preventers
- operate centrifugal pumps
- operate positive displacement pumps (mud pumps)
- operate generators
- operate compressors such as air and gas compressors
- maintain drawworks
- operate boilers and associated equipment
- operate automatic drilling equipment
- operate hoists, winches and pulleys
- operate cement and mud mixing equipment
- operate mud tank jets
- operate electrical distribution systems
- operate well-testers
- operate pumping units
- operate treaters
- operate valves and headers
- select rubber goods
- select sucker rods
- select valves and fittings
- select tubular goods
- select other goods and equipment
- transport goods and equipment
- operate tampers

D. Operating Vehicles
- operate pickup trucks
- operate four-wheel-drive vehicles
- operate tractors with attachments
- operate rig-up trucks
- operate vacuum trucks
- operate snowmobiles
- operate snowcats

E. Following Instructions
- use industry terminologies
- follow written instructions
- follow oral instructions
- interpret maps
- interpret schematic drawings

F. Maintaining Safe Work Environments
- comply with safety regulations
- dress properly for working conditions
- wear standard protective clothing such as hard hats and steel-toed footgear
- use protective equipment such as goggles
- use fire extinguishers
- apply first aid techniques
- identify proper management of potentially hazardous materials
- operate vehicles safely (defensive driving)
- use hand and power tools safely
- report worn, damaged or defective equipment
- identify blow-out prevention techniques

G. Handling Information
- perform basic arithmetical calculations
- read meters such as electric and gas meters
- record data from gauges, tapes and instruments
- read sight gauges
- record pressures and volumes
- record temperatures
- use conversion charts
- keep equipment maintenance logs

H. Handling Samples
- collect crude oil samples
- test crude oil for basic sediment water (BS&W), gravity and temperature
- collect drilling mud samples
- test drilling mud for weight and viscosity
- collect produced and injection fluid samples
- collect chemical and natural gas samples
- collect drilling cuttings samples
- collect swab-run and corrosion samples
- perform complete analyses on drilling mud
- collect and analyze components of drilling cuttings (mud-logging)
- use microscopes
- operate mud-logging equipment
- prepare on-site general descriptions of core samples
- prepare core samples for shipping
- collect and prepare drill stem test samples
- collect samples for metallurgical analysis
- collect and prepare lubricating oil samples for analysis

- collect coolant samples for analyses
- collect and analyze produced and injection water samples
- perform basic and intermediate water analysis
- collect and prepare produced oils for analysis
- collect and prepare gas samples for analysis
- install and collect corrosion coupons
- perform basic analyses of corrosion coupons
- install and collect cathodic protection devices
- analyze cathodic protection devices

I. Gathering and Interpreting Data
- perform literature searches of various sources, including government
- locate and interpret available aerial/space photographs
- organize raw-well-test data such as fluid levels and bottom-hole pressures
- organize drilling data such as time, performance and cost data
- organize stratigraphic data
- gather information from metering systems
- maintain metering systems
- use surveying equipment
- organize completion and work-over data such as time, cost and performance data
- gather and organize production and injection data
- prepare graphs
- interpret, record and apply information from graphs
- prepare charts
- interpret, record and apply information from charts
- prepare drawings such as schematics
- interpret, record and apply information from drawings
- use basic drafting tools
- draft plans
- interpret, record and apply information from plans
- interpret, record and apply drilling data
- interpret, record and apply cost data
- interpret, record and apply well completion and work-over data
- interpret and apply computer outputs
- interpret, record and apply production and injection data
- interpret, record and apply well-test data
- interpret, record and apply metering data

J. Reporting and Filing Data
- prepare company forms
- prepare government forms
- maintain drilling reports
- maintain production reports
- file reports and forms
- prepare exhibits and displays

K. Identify Drilling Operations
- define petroleum geology
- define petroleum safety
- identify parts of a drilling rig
- identify basic drilling procedures
- define blowout prevention
- identify special problems in drilling
- define deviation control
- define offshore, industrial and directional drilling methodology

L. Identify Well Servicing Operations
- define oil well completion procedures
- maintain equipment
- define oil well servicing procedures
- define oil well workover procedures
- identify well closing and re-entry procedures

M. Production
- identify oil well construction methods
- identify vessel installation
- identify petroleum drafting methods
- define oil treatment procedures
- define scale and corrosion components
- define cathodic protection
- identify lease automation systems
- define hydraulics and pneumatics
- identify automatic controls
- identify flowing well operations
- define gas lift and injection procedures
- identify components of industrial physics
- define engine maintenance procedures
- identify air compressors and electric motors
- define petroleum electricity
- identify mechanical pumping units
- identify centrifugal and hydraulic lifts
- identify petroleum economics

VII. OCCUPATIONAL HEALTH, SAFETY AND MATERIAL HANDLING

A. Maintain Facilities and Grounds
- develop a general maintenance schedule for facilities and grounds
- supervise employees in maintenance and repair activities
- arrange for repairs and services
- order materials and supplies

B. Supervise Firefighting Crews
- determine fire potential in a given area
- use appropriate fire control measures
- identify and correct potential fire dangers
- supervise maintenance of fire lines
- assist in supervision of firefighting crews and support services

C. Identify Employee Job Requirements
- maintain open communications
- set up work schedules
- provide technical information and data
- provide instruction and training for employees
- maintain personnel records
- maintain employee welfare and safety through training and information
- interpret and apply laws and regulations relative to the operation
- list agencies responsible for administering regulations relative to occupation
- interpret laws and regulations for landowners
- secure permits and certificates as required by law

SUMMARY

Technical Committee members for Mining and Minerals agreed that vocational schools in Montana must adequately train its workers to assure the necessary supply for future demands.

A fairly high demand for well-trained mining and mineral workers is forecasted for the next five years. While the demand is not great at the present time, the price of gold, oil and other minerals will dictate the global needs of the future.

Continued training and re-training in the sophisticated technology areas is a first priority for mining and mineral workers, the committee stated.